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THE RECREATIONAL WATER QUALITY
OF
KAMISKOTIA LAKE
TIMMINS



Ontario

Ministry
of the
Environment

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THE RECREATIONAL WATER QUALITY

OF

KAMISKOTIA LAKE

TIMMINS



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ACKNOWLEDGEMENTS

The recreational water quality survey of Kamiskotia Lake was a co-operative venture between the Technical Support Section of the Northeastern Region, the Timmins District Office and the Microbiology Section of the Laboratory Services Branch.

The authors, G. Myslik, G. S. Hendry, S. Janhurst and P. Bolton wish to acknowledge the contributions of the following:

H. W. Hunter and R. Goard for preparation of maps and figures.

R. Goard for phosphorus budget calculations.

D. Johnston and D. Zetts for bacteriological laboratory assistance.

S. Legault for typing the manuscript.

INTRODUCTION

Kamiskotia Lake is an important resource to the City of Timmins. It sustains heavy recreational use including fishing, boating, swimming and water skiing.

Water quality problems consisting of recurring algae blooms, minor fish kills and high turbidity have been reported to the Ministry of the Environment.

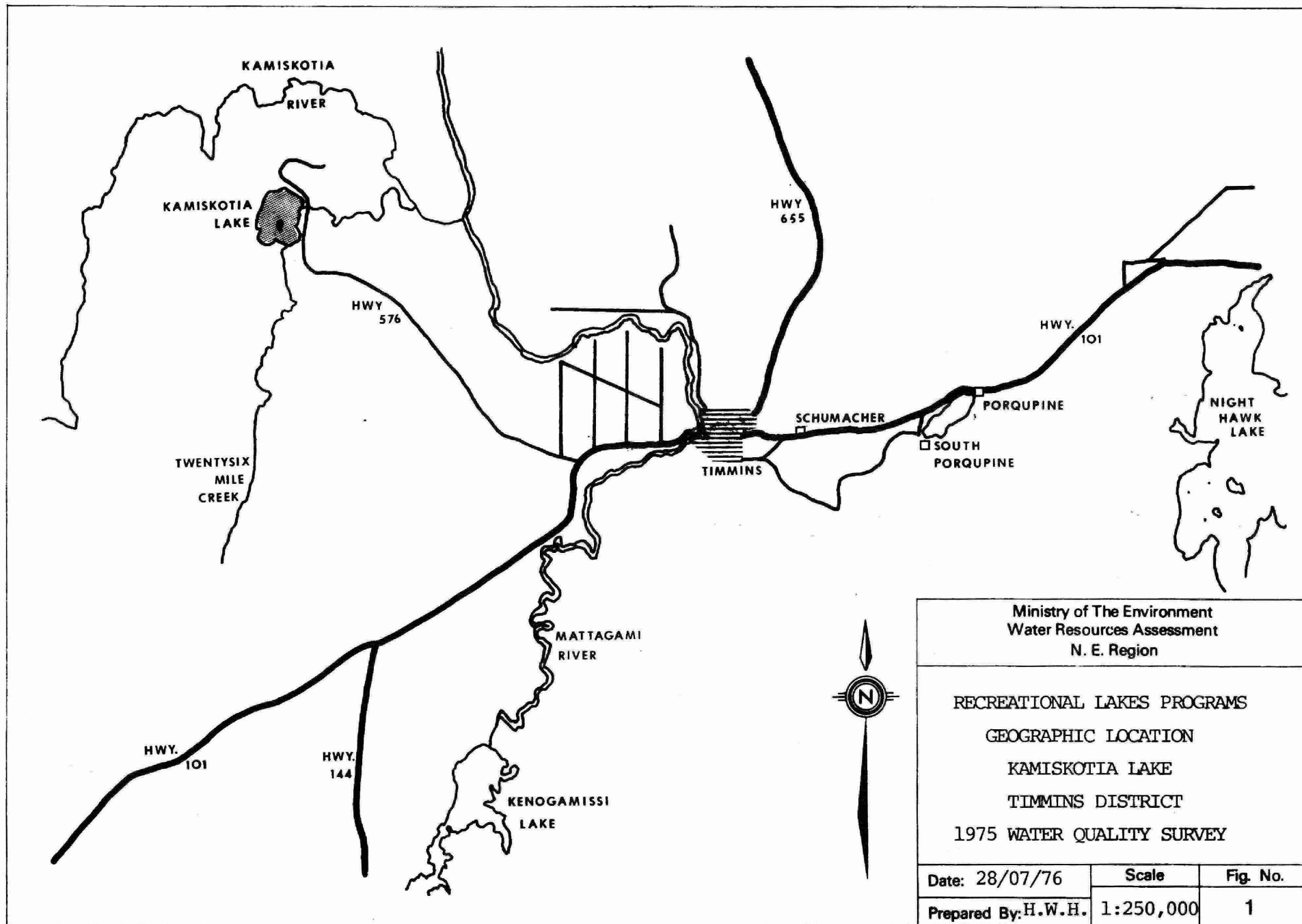
The concerns of local residents and government agencies regarding the status of water quality in Kamiskotia Lake prompted a lake quality survey during the summer of 1976.

The purpose of the survey was to define the chemical and bacteriological water quality of Kamiskotia Lake as it pertains to the recreational pressure to which the lake is subjected.

Data obtained during the study were used to calculate a phosphorus budget for the lake. The potential effect of further housing development on this budget and the projected impact on existing water quality were examined.

STUDY AREA DESCRIPTION

Kamiskotia Lake is situated west of Highway 576 in Robb Township, Cochrane District. The nearest large population centre, the City of Timmins, is located approximately 24 kilometres southeast of the lake (Figure 1).



Kamiskotia Lake is found in the arctic watershed. The surficial geology is dominated by lacustrine deposits including sands, clays, silts and gravel.

Kamiskotia Lake's physical characteristics are listed below:

Surface area	$4.97 \times 10^6 \text{ m}^2$
Maximum depth	6.2 m
Mean depth	2.4 m
Volume	$11.8 \times 10^6 \text{ m}^3$
Flushing rate	2.2/yr.

The drainage basin, whose topography is mainly characterized by flat, sometimes swampy terrain with infrequent rolling hills, covers an area of approximately 65 km^2 .

Kamiskotia Lake has two inlets, Robb Creek and Twenty-six mile Creek which flow in at the southwestern and southern shores respectively. A minor inflow is also found in the public park and boat launch area at the north end of the lake.

There is one outlet, the Little Kamiskotia River which flows out of the northeast corner of the lake.

Based on 1976 City of Timmins survey data, there are 99 cottages and 28 permanent year round residences located along the shoreline.

Kamiskotia Lake supports a warm-water fishery with yellow pickerel, northern pike and yellow perch, being the main species available to anglers.

The main concerns expressed by local residents involved general pollution inputs from the cottages and contaminated surface drainage from base metal mining operations located in the northeastern sector of the watershed.

SURVEY PROCEDURES

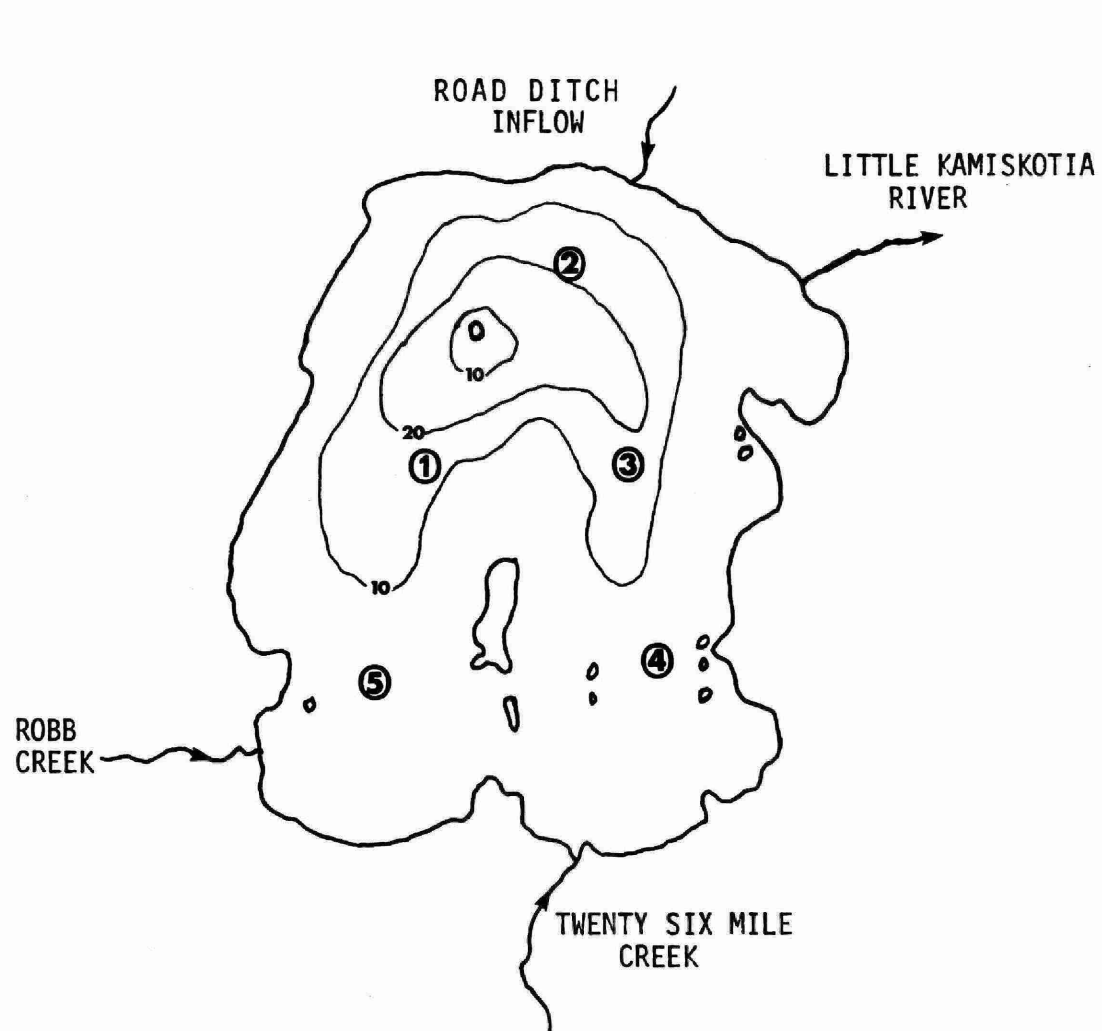
a) Chemical Water Quality

Up to five stations on the lake were sampled on three separate occasions during the spring and summertime period of 1976 (Figure 2).

On May 26, composite samples of the euphotic zone (two times Secchi disc visibility or depth of effective light penetration) were taken for water chemistry analysis. On June 16 and August 11, water samples for chemical analysis were obtained one metre below the surface and one metre off the bottom with a Van Dorn bottle.

Chemical analyses performed on water samples included:

hardness	sulphate
alkalinity	total phosphorus
pH	total Kjeldahl nitrogen
conductivity	ammonia
colour	nitrite
calcium	nitrate
magnesium	inorganic carbon
chloride	iron



① - SAMPLING STATIONS

Ministry of The Environment
Water Resources Assessment
N. E. Region

KAMISKOTIA LAKE
CHEMICAL SAMPLING
STATIONS

CONTOUR INTERVALS IN FEET

Date: APR. 12/78	Scale	Fig. No.
Prepared By: RG	2" = 1mi.	2

Because Kamiskotia Lake is near the base metal mining operations in adjacent Jamieson Twp. the presence of the following heavy metals was also investigated:

copper	zinc
nickel	cobalt
lead	chromium

Similar analyses were also performed for the inflows and outflow during the June sampling run.

Water transparency was measured on five separate occasions, twice in 1975 and three times in 1976. A Secchi disc (20 cm diameter metallic disc printed in alternate black and white quadrants) was lowered into the water until it disappeared from view. At the same time, water samples for chlorophyll a determination (the green pigment of algae) were secured as euphotic zone composites.

Dissolved oxygen and temperature profiles at one metre depth intervals were developed at each sampling location during the June and August chemical surveys by means of a Y.S.I. Model 54 combination meter.

Chemical analyses other than pH, which was determined subsequent to sample collection, were carried out at the Ministry of the Environment Laboratory in Toronto.

Chemical Tests and Interpretation

The determination of chemical water quality involves evaluation of the concentrations and distribution of particular chemical species. Characterization parameters which are used to "describe" a water include:

Hardness, the soap consuming ability of a water.

Calcium and Magnesium, the major cations contributing to hardness.

Conductivity, a measure of the ability of water to pass an electric current. It is used as an indication of quantities of dissolved substances.

pH, a measure of acidic or basic properties of water. A reading above 7 is basic while values less than 7 are acidic.

Colour, a determination of the intensity of the yellow-orange hue contributed to lakes by organic material or iron.

Alkalinity, a measure of a waters' ability to resist pH change from acidic inputs.

Nutrient parameters including; total phosphorus, the four interrelated forms of nitrogen, and inorganic carbon are used to determine the enrichment or trophic status of a lake.

Nutrient poor or oligotrophic lakes are ususally very clean and clear while eutrophic or nutrient rich lakes are characterized by turbid water caused by extensive growths of algae and aquatic weeds.

Other chemical species examined are iron, which can impart colour, odour and taste to natural water, and chloride and sulphate which can be indicative of pollution inputs resulting from the activities of man.

Where the possibility of mining or waste rock drainage exists, the concentrations of heavy metals which can have either chronic or acute toxic effects on plant and animal life are investigated.

Indications of lake trophic status and water quality are also obtained from the investigation of biological and physical conditions.

Primary biological activity is evaluated by measuring the concentration of chlorophyll a the green pigment in algae (tiny plants suspended in the water column). At the same time, water clarity or transparency is determined by lowering a black and white Secchi disc until it disappears from view.

The mid to late summer vertical distributions of dissolved oxygen and water temperature can be used to explain many of the conditions encountered and to estimate the potential for the occurrence of specific water quality problems.

b) Bacteriological Water Quality.

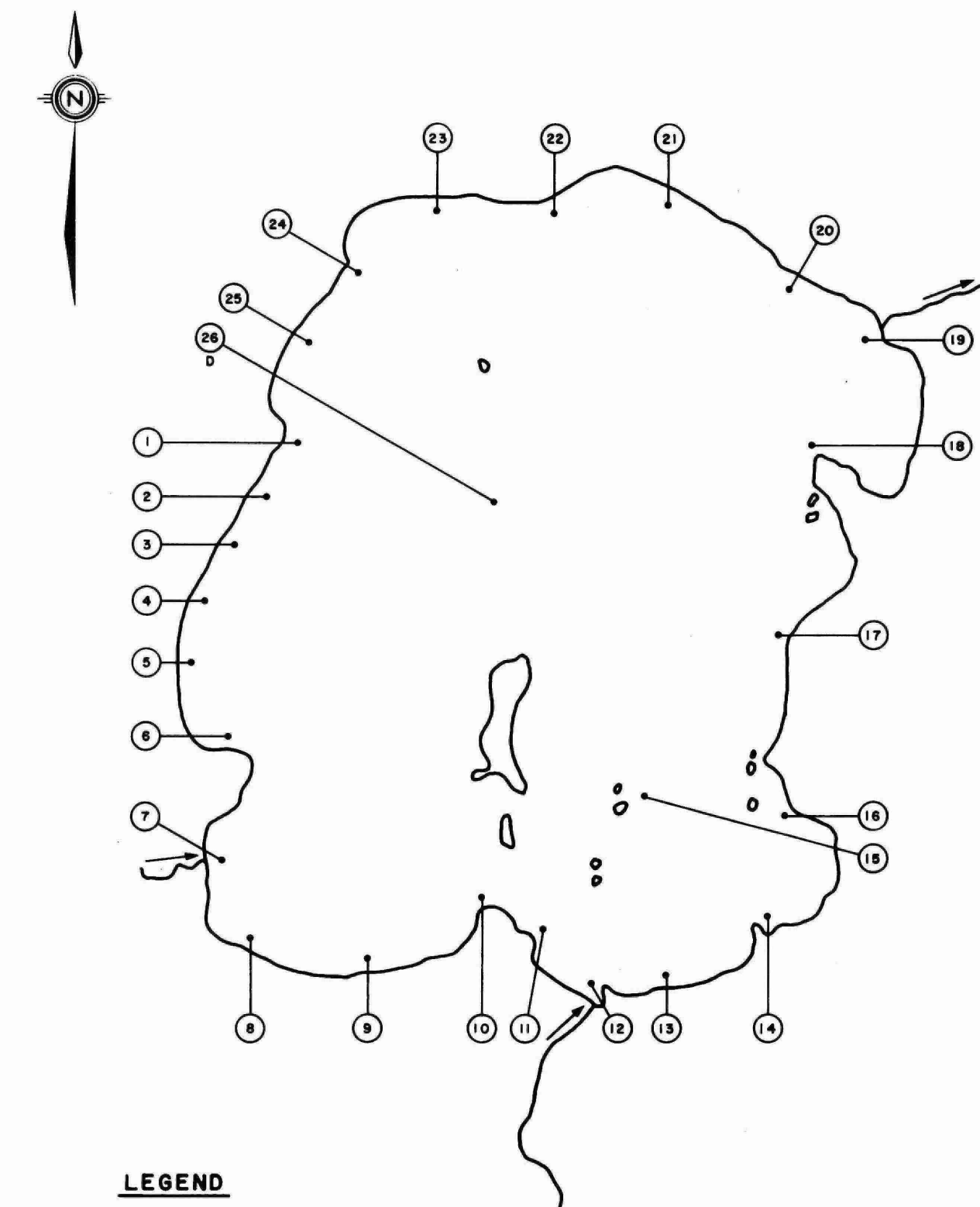
One five-day bacteriological survey was carried out between June 13 and June 17, 1976. A second survey was extended to six days from August 5 to August 10 because of irregular sampling on August 7.

The bacteriological sample stations were located at the midlake, inflows, outflows and in areas considered to be representative of the various degrees of shoreline development found on the lake. Samples were taken at 24 shoreline locations, 2 midlake and 1 depth station (Figure 3). The samples were obtained one metre below the surface, as well as one metre above the bottom at the midlake station.

Bacteriological Tests and Interpretation

Four kinds of bacteria, total coliform, fecal coliform, fecal streptococcus and Pseudomonas aeruginosa are all indigenous to man and other warm-blooded animals, and are found in the colon and feces in tremendous numbers.

FIGURE 3 - LOCATION OF BACTERIOLOGICAL SAMPLING STATIONS ON KAMISKOTIA LAKE



LEGEND

- ⑦ — BACTERIOLOGICAL SAMPLE ONLY
 C
P
⑧ CH — BACTERIOLOGICAL SAMPLE AND
D
 C — CHEMISTRY SAMPLE
 P — PROFILE (TEMPERATURE AND DISSOLVED OXYGEN)
 CH — CHLOROPHYLL SAMPLE
 D — DEPTH SAMPLE

MINISTRY OF THE ENVIRONMENT

RECREATIONAL LAKES PROGRAM

KAMISKOTIA LAKE

1976 WATER QUALITY SURVEY

SCALE: AS SHOWN

DRAWN BY: A.R.S.

DATE: JUNE, 1977

CHECKED BY:

DRAWING Nº: 7103

Many diseases common to man can be transmitted by feces; consequently, the probability of occurrence of these diseases is highest in areas where the water is contaminated with fecal material. These "indicator" organisms in water connote the possible presence of disease causing organisms.

The density of the indicator bacteria in water will vary considerably between samples taken at the same station, or at different stations on a lake, or if taken at different times; and so, the assessment of water quality cannot be determined accurately from a single water sample. Bacteriological surveys require many samples to be taken at several lake stations over a period of time.

The large amount of data obtained during sampling periods are reduced by calculations to meaningful and easily manipulated statistics. These data are then evaluated by the following statistical techniques. The geometric mean, the most appropriate central value, and variance are calculated for the values of each of the four kinds of indicator bacteria at every station. Statistically significant variations in the bacterial densities between stations, or groups of stations, are determined by a One-Way Analysis of Variance and Bartlett's Test of Homogeneity. By these means, the data from each station are tested against that of every other station until all stations with similar geometric mean densities are separated into groups (Group A, B).

The group results and those for individual stations are identified by different stippling on summary maps. Within each stippled area, the group geometric mean applies for each type of bacteria unless otherwise indicated by individual station values. The areas of better or worse bacterial densities are defined by the group geometric mean densities; and so, any inputs of bacterial contamination, and the area they affect, are identified.

SURFACE WATER CHEMISTRY CHARACTERISTICS

Results of euphotic zone water chemistry sample analysis are shown in Table 1. Three locations corresponding to stations 2, 3 and 5 in Figure 2 were sampled on May 26.

Surface water chemistry data characterize Kamiskotia Lake as a softwater (hardness 37-48 mg/l) tea coloured (colour 40-60), slightly basic (pH 7.3) lake with a moderate load of dissolved substances (conductivity 85 umhos/cm) and good buffering capacity (alkalinity 29 mg/l). Concentrations of the major nutrient elements, phosphorus (.016 - .019 mg/l) and nitrogen (.5 - .6 mg/l) were moderately high while inorganic carbon concentrations were moderate (3.3 - 4.2 mg/l).

Concentrations of iron in the surface water were moderate ranging from .22 to .28 mg/l and were below the drinking water criterion of .30 mg/l.

The major cations, calcium (10-12 mg/l) and magnesium (2 mg/l) were present in moderate quantities while concentrations of chloride (1.6 mg/l) and sulphate (14.5 mg/l) were moderately low.

TABLE I

CHEMICAL WATER QUALITY OF KAMISKOTIA LAKE

MAY 26, 1976

<u>PARAMETER</u>	<u>SAMPLING LOCATION</u>		
	2	3	5
Hardness	48	37	39
Alkalinity	29	28	29
pH	7.3	7.3	7.3
Conductivity	85	85	85
Colour	60	60	40
Calcium	12	10	10
Magnesium	2.0	2.0	2.0
Chloride	1.8	1.5	1.6
Sulphate	14.5	14.0	14.5
Total Phosphorus	.019	.016	.018
Total Kjeldahl Nitrogen	.50	.49	.58
Ammonia	.02	.02	.01
Nitrite	.003	.003	.003
Nitrate	.037	.005	.005
Inorganic Carbon	4.2	3.8	3.3
Iron	.28	.22	.22

* All concentrations in mg/l except pH, conductivity (umhos/cm) and colour (Hazen units).

TEMPERATURE AND DISSOLVED OXYGEN

Oxygen and temperature profiles for the five sampling stations were developed during the mid-June and August sample runs (Figures 4 and 5). Data for station 5 were similar to those obtained for station 4 and were excluded from the figures.

Because Kamiskotia Lake is relatively shallow, it is subject to uniform heating and oxygenation through wind and wave turbulence. No persistent thermal stratification is likely, although temporary thermal strata may develop early in the warming season.

On June 15, water temperatures of approximately 18°C were recorded from surface to bottom at each sampling station. Dissolved oxygen concentrations were high and ranged from 10 mg/l at the surface to 9 mg/l near the bottom.

On August 11, homothermal conditions were observed as uniform vertical temperatures of 18°C were recorded. Surface to bottom dissolved oxygen levels of 10 mg/l were well above the 5 mg/l lower limit required for the maintenance of warm-water fishes.

WATER CHEMISTRY EVALUATION

Minor variations in the water chemistry were observed during the sampling period (Tables I, II, and III). Within the characterization group, alkalinity, pH, conductivity, calcium, magnesium, chloride and sulphate increased over the summer.

KAMISKOTIA LK 1976

JUNE 15

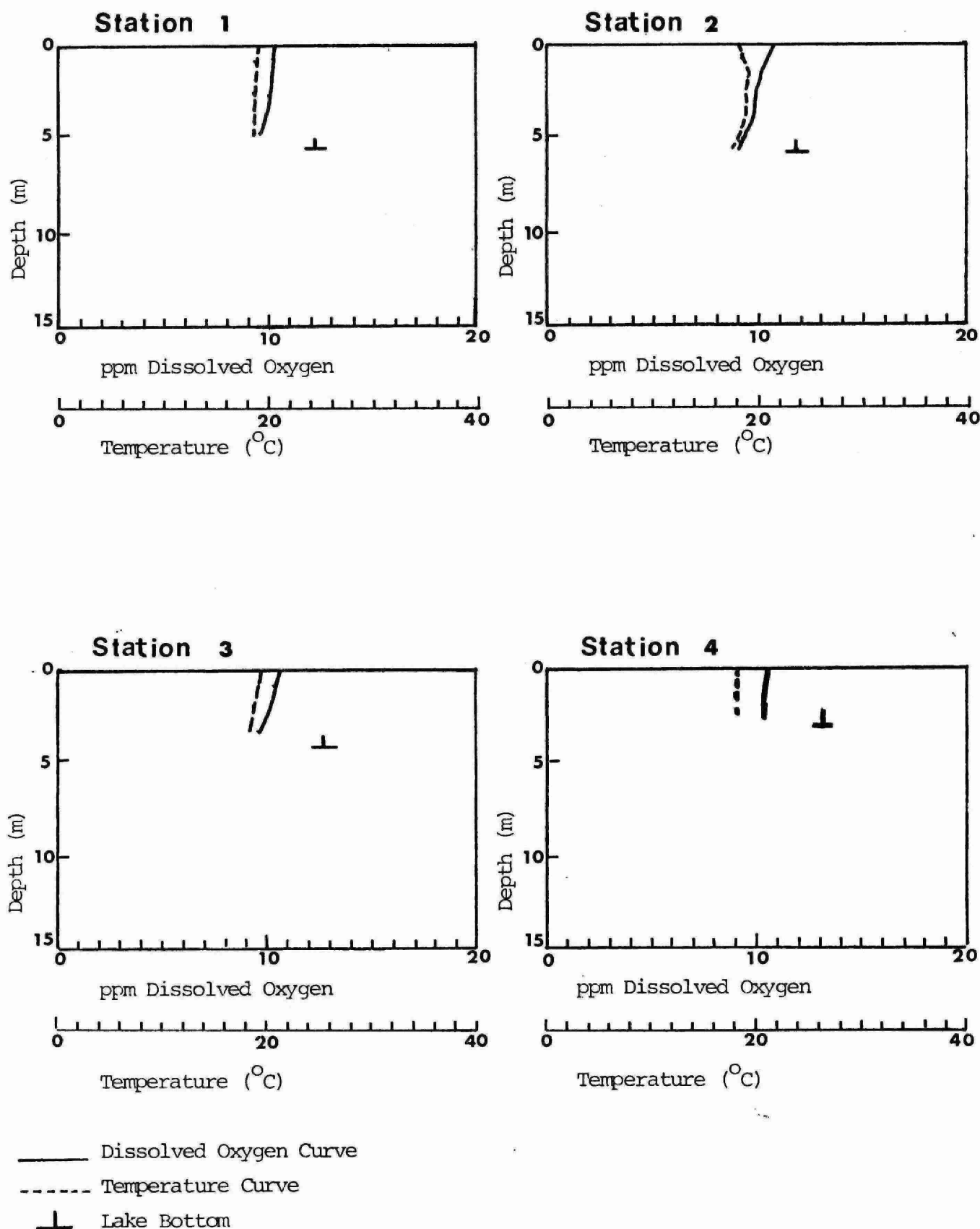


FIG 4

Summer 1976 Kamiskotia Lake
AUG II

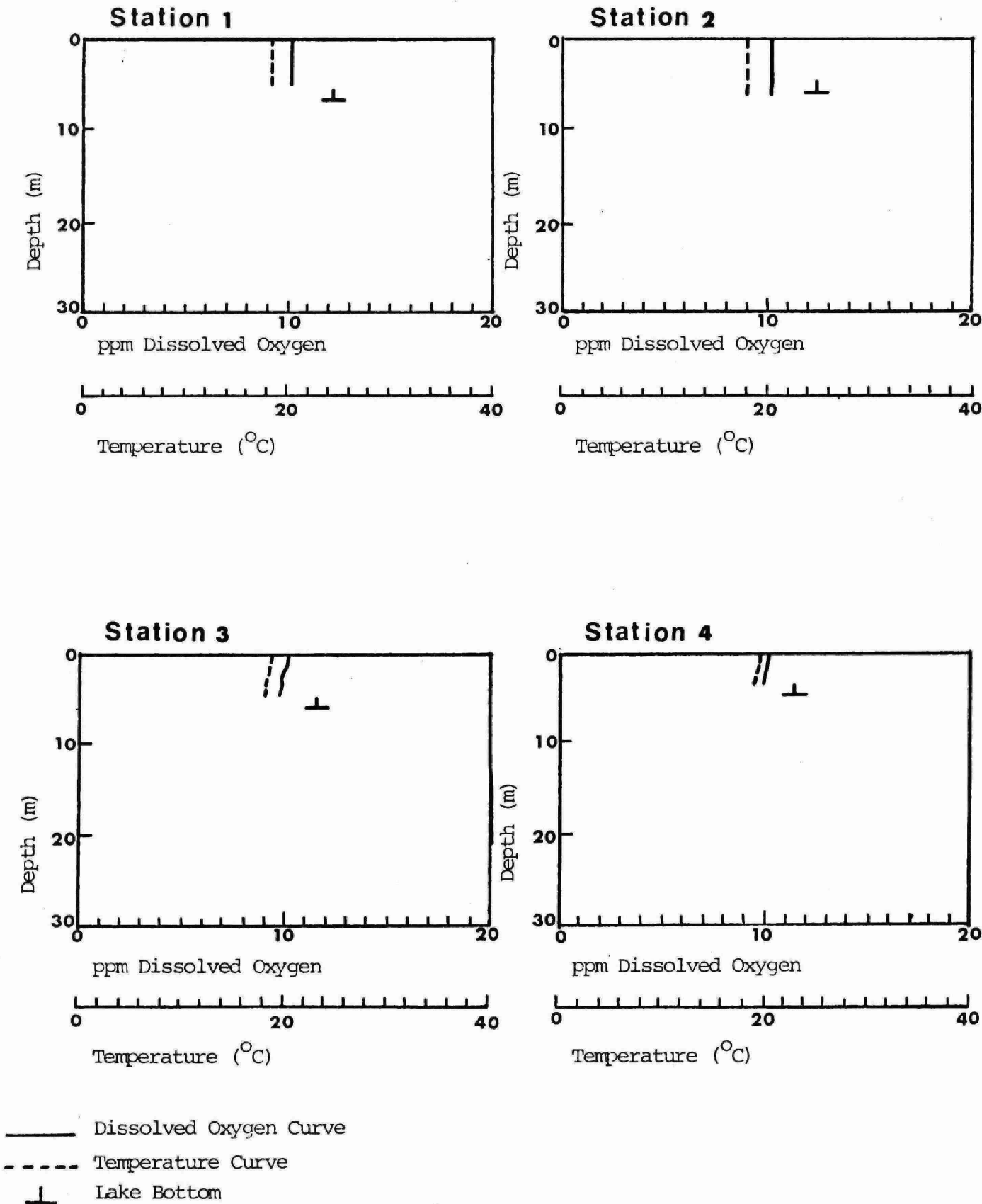


FIG 5

TABLE II

CHEMICAL WATER QUALITY OF KAMISKOTIA LAKE

JUNE 16, 1976

SURFACE (S) AND NEAR BOTTOM (B) WATERS

<u>PARAMETER</u>		<u>SURFACE</u> <u>BOTTOM</u>		<u>SAMPLING STATIONS</u>				
			1	2	3	4	5	
Hardness	S		59	54	54	-		54
	B		54	61	54	54		54
Alkalinity	S		31	30	30	-		30
	B		30	30	30	32		30
pH	S		7.6	7.7	7.7	-		7.6
	B		7.7	7.6	7.7	7.7		7.6
Conductivity	S		95	89	89	-		89
	B		92	89	89	89		89
Colour	S		60	50	50	-		60
	B		60	50	70	60		60
Calcium	S		13	12	12	-		12
	B		12	13	12	12		12
Magnesium	S		2	2	2	-		2
	B		2	2	2	2		2
Total Phosphorus	S		.027	.024	.056	-		.023
	B		.031	.026	.044	.067		.025
Total Kjeldahl Nitrogen	S		.50	.44	.48	-		.43
	B		.45	.51	.59	.45		.43
Ammonia	S		.026	.028	.004	-		.002
	B		.020	.022	.002	.004		.003
Nitrite	S		.004	.004	.003	-		.004
	B		.004	.004	.004	.004		.004
Nitrate	S	<	.005	< .005	< .005	-		< .005
	B	<	.005	< .005	< .005	< .005		< .005
Iron	S		.40	.32	.34	-		.32
	B		.46	.46	.90	.62		.38

* All concentrations in mg/l except pH, conductivity (umhos/cm) and colour (Hazen units).

CHEMICAL WATER QUALITY OF KAMISKOTIA LAKE

AUGUST 11, 1976

SURFACE (S) AND NEAR BOTTOM (B) WATERS

<u>PARAMETER</u>		<u>SURFACE</u> <u>BOTTOM</u>		<u>SAMPLING STATIONS</u>				
		1	2	3	4	5		
Hardness	S	48	48	48	48	48		
	B	48	48	48	48	48		
Alkalinity	S	34	34	34	35	35		
	B	34	35	34	35	34		
pH	S	7.8	7.7	7.7	7.7	7.7		
	B	7.7	7.6	7.7	7.6	7.7		
Conductivity	S	100	100	99	99	99		
	B	102	100	100	100	99		
Colour	S	40	40	40	40	40		
	B	40	40	40	40	40		
Calcium	S	13.8	13.8	13.8	13.8	13.8		
	B	13.8	13.8	13.8	13.8	13.8		
Magnesium	S	3.4	3.4	3.4	3.4	3.4		
	B	3.4	3.4	3.4	3.4	3.4		
Total Phosphorus	S	.010	.010	.012	.014	.016		
	B	.014	.013	.018	.022	.016		
Total Kjeldahl Nitrogen	S	.36	.36	.36	.38	.38		
	B	.38	.38	.44	.44	.38		
Ammonia	S	.022	.020	.020	.020	.020		
	B	.020	.020	.020	.016	.018		
Nitrite	S	.002	.002	.002	.002	.002		
	B	.002	.002	.002	.002	.002		
Nitrate	S	< .005	< .005	< .005	< .005	< .005		
	B	< .005	< .005	< .005	< .005	< .005		
Iron	S	.16	.26	.18	.14	.14		
	B	.32	.32	.16	.32	.14		
Chloride	S	2.2	2.2	2.2	2.2	2.2		
	B	2.2	2.4	2.2	2.2	2.2		
Sulphate	S	15	15	15.5	15	15		
	B	15	15	15	15	15.5		

* All concentrations in mg/l except pH, conductivity (umhos/cm) and colour (Hazen units).

	<u>MAY</u>	<u>JUNE</u>	<u>AUGUST</u>
alkalinity	29	30	34
pH	7.3	7.7	7.7
conductivity	85	90	100
calcium	11	12	14
magnesium	2	2	3.4
chloride	1.6	--	2.2
sulphate	14.5	--	15

* These values are lake-wide averages in mg/l except pH and conductivity (umhos/cm).

The observed seasonal increasing quantities of characterization parameters were likely related to precipitation and runoff events in the watershed. Lower quantities of dissolved substances are usually found in the spring (May samples) because of the influence of dilute snow melt. As the summer progresses, lake evaporation and more concentrated runoff from the drainage area tend to increase the dissolved solids content.

Because Kamiskotia Lake is shallow and easily mixed by wind turbulence, it was not surprising to find no thermal layering. Water chemistry from surface to bottom was reasonably uniform.

The pH readings during the sampling period were consistently above the neutral point of 7 and were within the favourable range for the support of fish populations.

Iron concentrations in the water column ranged from a moderate level of 0.14 mg/l to a high level of 0.90 mg/l. During both the June and August sampling periods the drinking water criterion of 0.30 mg/l was exceeded.

It is suspected that the moderate to high concentrations of iron present were a natural expression of watershed surficial geology, organic swamp runoff and chemical conditions in the lake. For example, it is probable that the highest levels of iron, .32 - .90 mg/l recorded during the June 16 sample period, were residual from a build-up of iron near the bottom of the lake under chemical reducing conditions. A complete mixing of the water column by storm action could have been responsible for the high values detected.

Although it is thought that the elevated iron concentrations were natural, the possibility that previous base metal mining activities northeast of the lake may have been a source of iron cannot be ruled out. Heavy spring runoff would be the most likely mode of iron transport to Kamiskotia Lake.

Colour determinations appeared to be related to the quantity of iron present. Values between 40 and 70 Hazen units characterized the lake's yellow-brown tea-like appearance. Organic acids from swamp drainage also contributed to the colour observed.

NUTRIENT CHARACTERISTICS

Total phosphorus concentrations ranged from a moderately high average of .018 mg/l in May, through an elevated level of .036 mg/l in June and back down to a moderate concentration of .012 mg/l in August.

The increase in phosphorus during the June sampling period was not considered to be a measure of "cottage pollution". Because iron concentrations increased concurrently (iron and phosphorus behave in a similar fashion) it is suspected that the increase was the result of lake mixing following breakdown of a shallow temporary thermal stratification and chemical reducing conditions near the bottom.

In the normal course of decomposition of nitrogenous organic matter, nitrogen goes through the following changes:

total Kjeldahl nitrogen to ammonia which is oxidized through the unstable nitrite form to nitrate.

Concentrations of total Kjeldahl nitrogen in May (.52 mg/l) and June (.48 mg/l) were high. In August, a moderate average concentration of .39 mg/l was determined.

On all sampling dates inorganic nitrogen concentrations (sum of ammonia, nitrite and nitrate) were low suggesting rapid uptake of this nutrient by aquatic plant life.

Inorganic carbon concentrations measured in May were moderate.

INFLOWING STREAM WATER CHEMISTRY

The water chemistry of the major inflows and the outlet of Kamiskotia Lake were investigated on June 16, 1976. Chemical data (Table IV) revealed that neither Twenty-six mile nor Robb Creeks had significantly different water chemistry from Kamiskotia Lake. Characterization parameters were present in similar concentrations as were moderate quantities of nutrients.

TABLE IV

CHEMICAL COMPOSITION OF KAMISKOTIA LAKE

INFLOWS AND OUTLET

JUNE 16, 1976

<u>PARAMETER</u>	<u>LOCATION</u>			
	Inlet at Boat Launch	Twenty Six Mile Creek	Robb Creek	Outflow, Little Kamiskotia River
Hardness	50	40	40	45
Alkalinity	38	33	34	32
pH	7.8	7.6	7.6	7.6
Conductivity	116	90	92	92
Colour	> 70	60	50	50
Calcium	16	12	12	13
Magnesium	2.5	2.5	2.5	3
Chloride	2.2	2.0	2.0	2.0
Sulphate	14	14.5	14.5	14.5
Total Phosphorus	.061	.025	.024	.020
Total Kjeldahl Nitrogen	.39	.53	.49	.41
Ammonia	.002	.002	.016	.016
Nitrite	.005	.004	.003	.004
Nitrate	.005	< .005	< .005	< .005
Iron	.14	.46	.32	.38

* All concentrations in mg/l except pH, conductivity (umhos/cm) and colour (Hazen units).

The inlet at the boat launch and public park area had a higher load of dissolved substances (conductivity 116 umhos/cm) and a much higher phosphorus content (.061 mg/l) than the receiving water. However, because this is a very minor and likely intermittent inflow originating in a road ditch along Hwy. 576, it is not expected to have a measurable influence on the water quality of Kamiskotia Lake.

HEAVY METAL CONTENT

Since Kamiskotia Lake is situated in an area where mining is the major industrial activity, the presence of potentially toxic heavy metals in the lake and its inflows was investigated. Tables V and VI summarize results of heavy metal analyses performed on June 16 and show that except for zinc (.05 - .10 mg/l), the metals were present in low concentrations at or below the detection limits.

Although the concentrations of zinc detected were within the range that can theoretically give rise to chronic toxicity problems in soft waters (hardness less than 100 mg/l) they appear to be general to the drainage system and are likely a reflection of environmental availability of the metal rather than an indication of lake pollution (Table VI).

CHLOROPHYLL a SECCHI DISC

Because a complete record of chlorophyll a concentrations and Secchi disc visibilities was not available for 1976, readings obtained in June and August of 1975 were included in the evaluation.

Averages of lake-wide determinations of chlorophyll a and Secchi disc visibilities are tabled below and are summarized in Figure 6.

HEAVY METAL CONCENTRATIONS OF KAMISKOTIA LAKE

JUNE 16, 1976

<u>PARAMETER</u>	<u>SAMPLE LOCATION</u>				
	1	2	3	4	5
Copper	.02	.02	.01	.01	.01
Nickel	.01	.01	.01	.01	.01
Lead	< .01	< .01	< .01	< .01	< .01
Zinc	.06	.10	.08	.08	.05
Cobalt	< .01	< .01	< .01	< .01	< .01
Chromium	.01	< .01	< .01	< .01	.02

TABLE VI

HEAVY METAL CONCENTRATIONS OF KAMISKOTIA LAKE

INFLOWS AND OUTLET

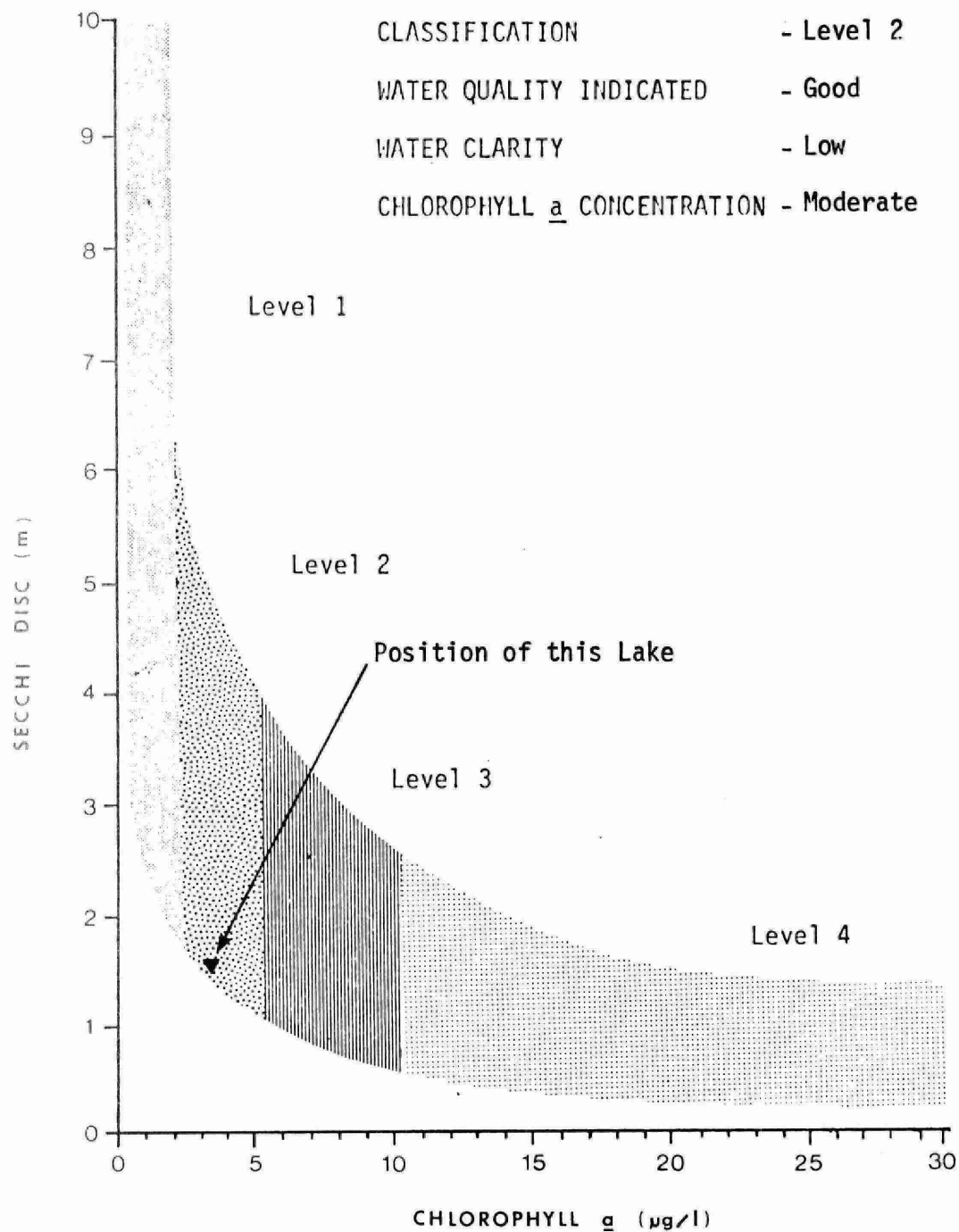
JUNE 16, 1976

<u>PARAMETER</u>	<u>SAMPLE STATION</u>			
	Inlet at Boat Launch	Twenty Six Mile Creek	Robb Creek	Outflow, Little Kamiskotia River
Copper	.03	.01	.01	.01
Nickel	.01	.01	.01	.01
Lead	< .01	< .01	< .01	< .01
Zinc	.10	.06	.06	.08
Cobalt	< .01	< .01	< .01	< .01
Chromium	< .01	< .01	< .01	< .01

All concentrations in mg/l.

KAMISKOTIA LAKE ROBB TWP.

1975-76

LAKE CLASSIFICATION BASED ON CHLOROPHYLL a
SECCHI DISC RELATIONSHIP

KEY: Secchi Disc Visibility(m)

- 5 + excellent
- 2.5 - 5 moderate
- 1 - 2.5 low
- 0 - 1 poor

Chlorophyll a Concentration($\mu\text{g/l}$)

- 0 - 2 low
- 2 - 5 moderate
- 5 - 10 high
- 10 + excessive

FIG. 6

<u>DATE</u>	<u>AVERAGE SECCHI-DISC</u>	<u>CHLOROPHYLL a</u>
	<u>VISIBILITY (m)</u>	<u>ug/l</u>
June 1975	1.5	2.8
August	1.25	2.9
May 1976	1.0	4.2
June	1.0	2.6
August	2.25	3.2
September	1.5	3.5
MEANS	1.4 m	3.2 ug/l

As shown, chlorophyll a concentrations averaged between 2.6 ug/l and 4.2 ug/l within the moderate range. The overall average of 3.2 ug/l was indicative of a moderate level of primary biological productivity.

Secchi disc visibility averaged between 1 and 2.25 metres and was within the low range. Low water transparency was the result of the suspension of fine silt and clay particles by wind and wave turbulence coupled with the deep orange-brown colouration.

BACTERIOLOGY

The results of the June and August surveys showed that the water quality of Kamiskotia Lake was good and well within the Ministry of the Environment recreational use criteria which state:

"Where ingestion is probable, recreational waters can be considered impaired when the coliform (TC), fecal coliform (FC) and/or enterococcus (fecal streptococcus, FS) geometric mean density exceeds 1000, 100 and/or 20 per 100 ml, respectively, in a series of at least ten samples per month including samples collected during weekend periods".

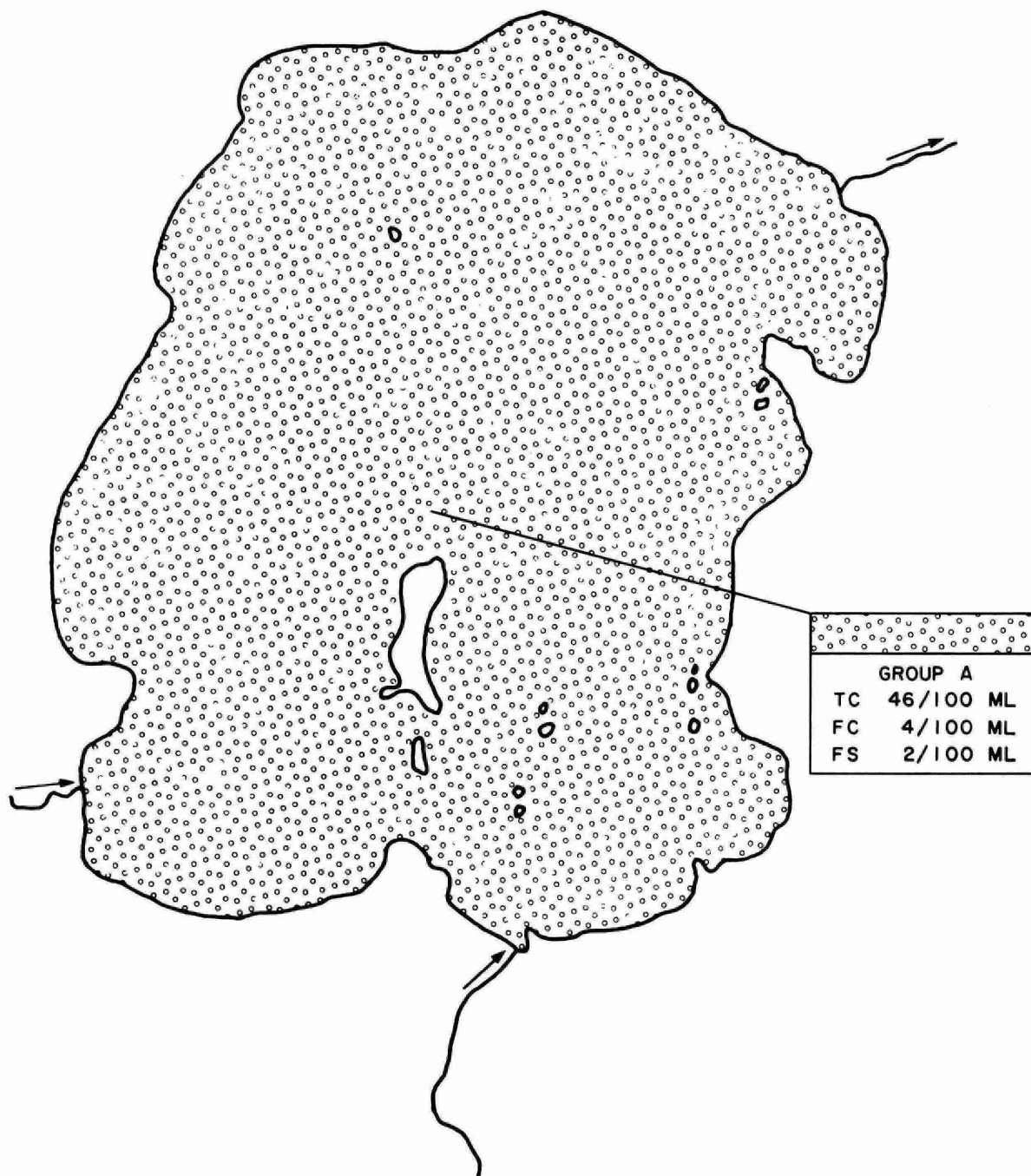
During the June survey, the water quality was very good. Bacterial levels were homogeneous throughout the lake for total coliform, fecal coliform and fecal streptococcus. The geometric mean densities for this period were 46 TC, 4 FC and 2 FS per 100 ml (Group A, Figure 7).

Pseudomonas aeruginosa (PsA) was not found during this survey.

In August, the mean bacterial densities for the main body of water were 12 TC, 2 FC and 4 FS per 100 ml (Group A, Figure 8). A few scattered stations were found to have higher counts. A stony section of shoreline with a small shed (station 20) had levels of 67 TC and 15 FC per 100 ml while a weedy area on the southwest shore (station 9) had 50 TC per 100 ml. The major inflow (station 12) was found to have densities of 65 TC and 29 FC per 100 ml. Elevated levels of bacteria have often been observed in inflowing streams as they may carry various materials such as soil, decaying matter and possibly animal and human wastes into the lake.

Although the bacterial counts at the above mentioned locations were above the mean for the main body of water they were still well below the acceptable limit. However, at the mouth of the outflowing stream (station 19), the level of

FIGURE 7 - DISTRIBUTION OF BACTERIA DURING THE
JUNE 13 TO JUNE 17 SURVEY



LEGEND

GROUP OR STATION	
TC	GM / 100 ML
FC	GM / 100 ML
FS	GM / 100 ML

GM - GEOMETRIC MEAN

MINISTRY OF THE ENVIRONMENT

RECREATIONAL LAKES PROGRAM

KAMISKOTIA LAKE

1976 WATER QUALITY SURVEY

SCALE: AS SHOWN

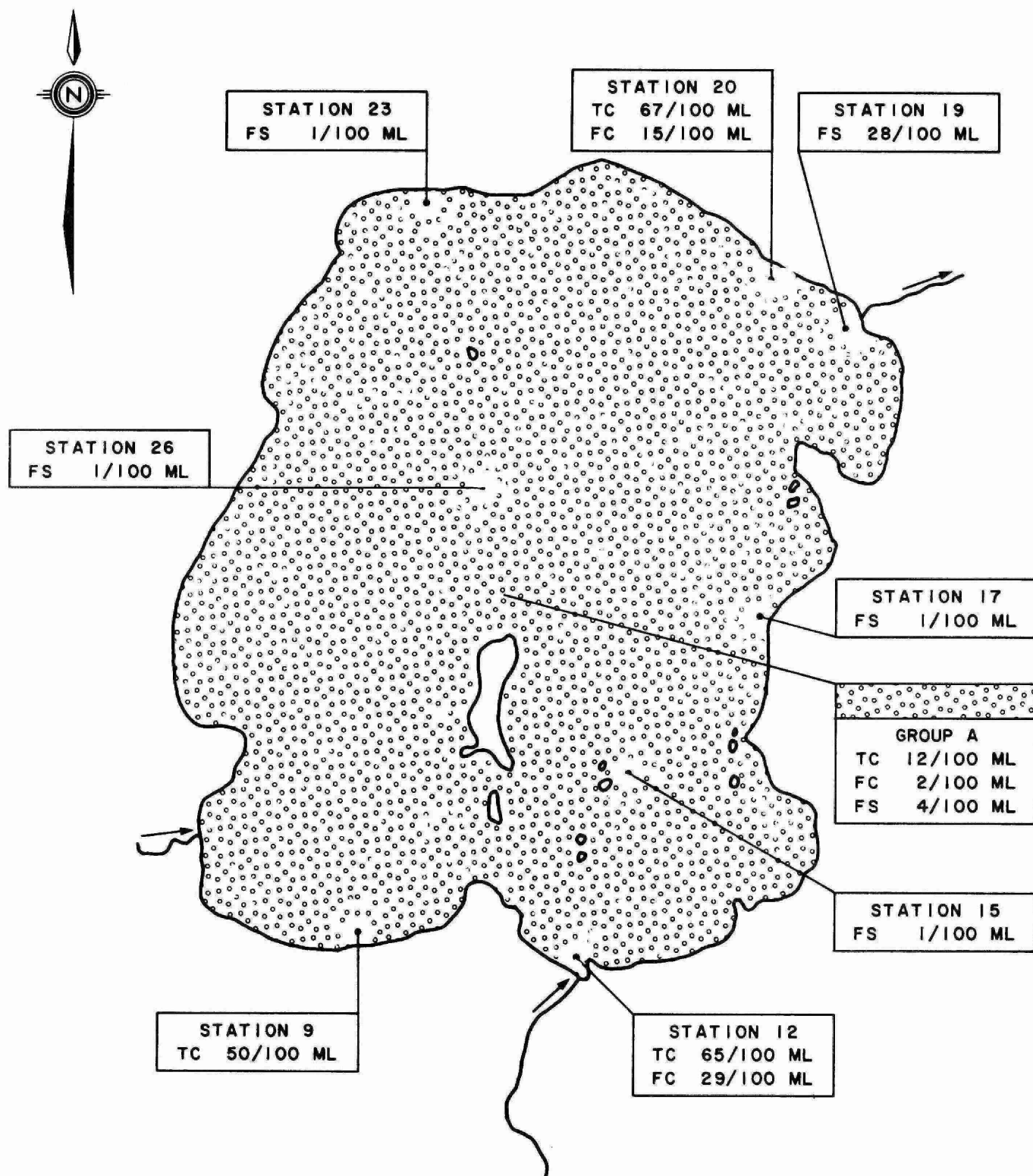
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DATE: JUNE, 1977

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**FIGURE 8 - DISTRIBUTION OF BACTERIA DURING THE
AUGUST 5 TO AUGUST 10 SURVEY**



LEGEND

GROUP OR STATION	
TC	GM/100 ML
FC	GM/100 ML
FS	GM/100 ML

GM - GEOMETRIC MEAN

MINISTRY OF THE ENVIRONMENT

RECREATIONAL LAKES PROGRAM

KAMISKOTIA LAKE

1976 WATER QUALITY SURVEY

SCALE: AS SHOWN

DRAWN BY: A.R.S.

DATE: JUNE, 1977

CHECKED BY:

DRAWING N°: 7103

enterococcus was 28 FS per 100 ml. The relative levels of fecal coliforms and fecal streptococci indicated that the bacterial contamination was probably of an animal or storm water source. This event was localized to the outflowing stream and did not appear to affect the rest of the lake. A number of locations (stations 15, 17, 23 and 26 surface and depth) had a density of less than 1 FS per 100 ml. This was significantly lower than the rest of the lake. Pseudomonas aeruginosa was not isolated during the survey.

The overall water quality of Kamiskotia Lake was very good. Although there was a slight deterioration over the summer period, the lake was suitable for recreational use during 1976.

KAMISKOTIA LAKE PHOSPHORUS BUDGET

In the Northeastern Region of the Ministry of the Environment, a phosphorus budget approach is being used as an indication of water quality and as a prediction of water quality changes likely to occur following the development of shoreline housing units.

It has been found (Dillon, 1974) that the trophic status (degree of nutrient enrichment) of lakes can be related to the amount of phosphorus present at spring turnover when the water is completely mixed.

General catagories or levels of water quality based on the quantity of total phosphorus present in the spring have been identified.

Level 1 (Excellent)

Springtime phosphorus concentrations between 0 and 9.9 mg/m³. Such lakes are primarily suited for body contact recreation because of extremely clear water and low order of biological productivity. In deep lakes, dissolved oxygen concentrations in hypolimnetic (bottom) waters will remain favourable for the support of cold water fish species like lake trout.

Level 2 (Good)

Springtime phosphorus concentrations between 10 and 18.5 mg/m³. Lakes in this category are suitable for water-based recreation but the preservation of cold water fisheries is not guaranteed. Level 2 lakes are less clear with moderate primary biological activity.

Level 3 (Fair)

Springtime phosphorus concentrations between 18.5 and 29.9 mg/m³. Level 3 lakes are characterized by reduced suitability for body contact aquatic recreation because of high concentrations of suspended algae and associated nuisances like odours and turbid water. Oxygen depletion in deep basins will be common and there is danger of winterkill of fish in shallow lakes.

Level 4 (Poor)

Springtime phosphorus concentrations above 30 mg/m³. Such lakes are suitable only for warm water fisheries and there is considerable danger of winterkill of fish. Other recreational uses like swimming, boating and water skiing are extremely unpleasant.

The springtime phosphorus concentration of Kamiskotia Lake was determined for 3 stations in May 1976 (Figure 9). Total phosphorus ranged from 16 to 19 mg/m³ and averaged 17.7 mg/m³. Kamiskotia Lake was classified as a Level 2 lake with a "good" order of water quality. However, the average spring phosphorus concentration was almost at Level 3 and water quality conditions associated with a "fair" classification would not be surprising.

Results and classification were in agreement with observations during the summertime water chemistry survey.

In the calculation of a phosphorus budget for Kamiskotia Lake two sources of phosphorus were considered:

1. the phosphorus originating from the drainage basin i.e. natural load from runoff and precipitation. An export factor of 10.3 mg/m²/yr was used because of the lacustrine (sedimentary) nature of watershed surficial geology.
2. the artificial phosphorus input from septic tank tile fields of existing cottages and houses. The input from 99 seasonal and 28 year-round residences was considered.

For the estimation of septic tank phosphorus inputs, it was assumed that all phosphorus present in human waste finds its way to the lake. This amounts to approximately 800 gms/yr/person. For this reason, estimates of the effect of additional development are maximum effect estimates.

SPRINGTIME PHOSPHORUS - 1976

KAMISKOTIA LAKE ROBB TWP.

AVERAGE SPRING PHOSPHORUS: 17.7 mg/m^3

CLASSIFICATION: Level 2

PREDICTED SUMMER CHLOROPHYLL a : 4.7 mg/m^3

AVERAGE SPRING SECCHI DEPTH: 1 m

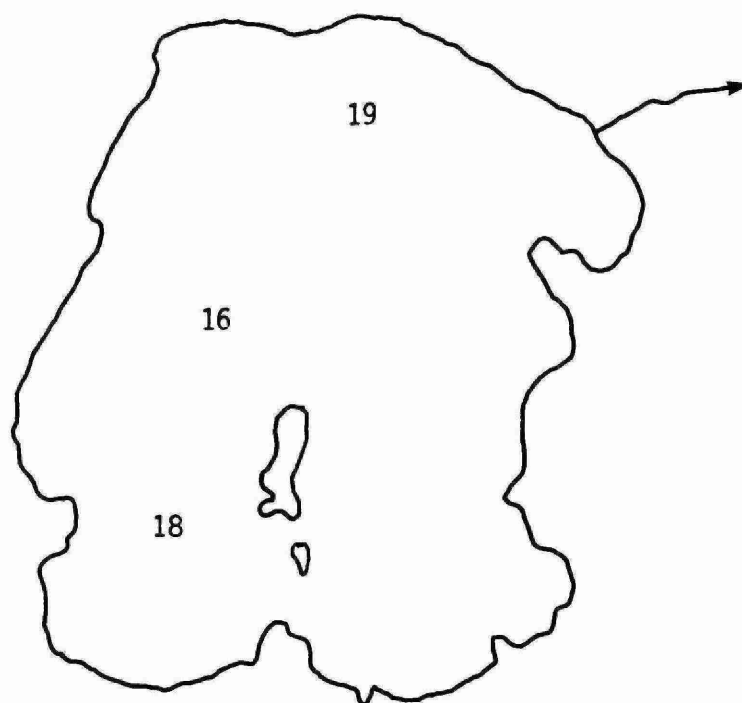


FIG. 9

Phosphorus budget and development capacity were computed on an Hewlett Packard 9825A system. Results are shown in the appended outputs. Based on theoretical phosphorus supply estimates, a springtime phosphorus concentration of 13 mg/m^3 was predicted. It does not compare favourably with the measured value of 17.7 mg/m^3 . There are likely other sources of phosphorus to the lake which are not accounted for in the model. These may include geological availability, private sewage disposal systems, and near-shore activities of land owners.

The more reliable, measured spring phosphorus value was used as a base for the calculation of development capacity.

With regard to water quality, Kamiskotia Lake has the capacity to accommodate an additional 119 cottages or 23 permanent dwellings before deterioration into the next (fair) category of water quality could occur.

This moderately high capacity is due to the relatively quick flushing rate of 2.2 times per year.

SUMMARY WATER QUALITY STATUS

The general chemical water quality of the Kamiskotia Lake was "good"; however, a tendency toward a lower or "fair" classification was observed. Because moderate concentrations of characterization chemicals, nutrients and algae were detected, Kamiskotia Lake is classified as a mesotrophic or moderately enriched body of water.

ONTARIO MINISTRY OF THE ENVIRONMENT - NORTHEAST REGION
LAKE DEVELOPMENT CAPACITY - DILLON'S MODEL

LAKE: Kamiskotia

TWP.: Robb

DATE: June 30 1978

SUMMARY: This lake is classified as a Level 2 lake. This means that the Spring Phosphorus Concentration ranges from 9.9 to 18.5 mg/cu.m. A maximum of 119 cottages or 23 permanent dwellings may be added to maintain a Level 2 classification.

The addition of 149 cottages or 29 permanent dwellings will result in a 1 mg/cu.m increase in the existing Spring Phosphorus Concentration. The full effect of any extra Phosphorus loading will be noticed after 0.4 years.

SUPPORTING DATA:

Lake Area(sq.m): 4974396
Drainage Area(sq.m): 65493210
Mean Depth(m): 2.38
Volume(cu.m): 11839062
Unit Runoff(m/yr): 0.3800
Precipitation(m/yr): 0.76
Evaporation(m/yr): 0.43
Total Outflow Volume(cu.m): 26528970
Flushing Rate(Lake's vol./yr): 2.2408
Retention Coefficient(R): 0.7122
Response Time(yr): 0.3 to 0.4

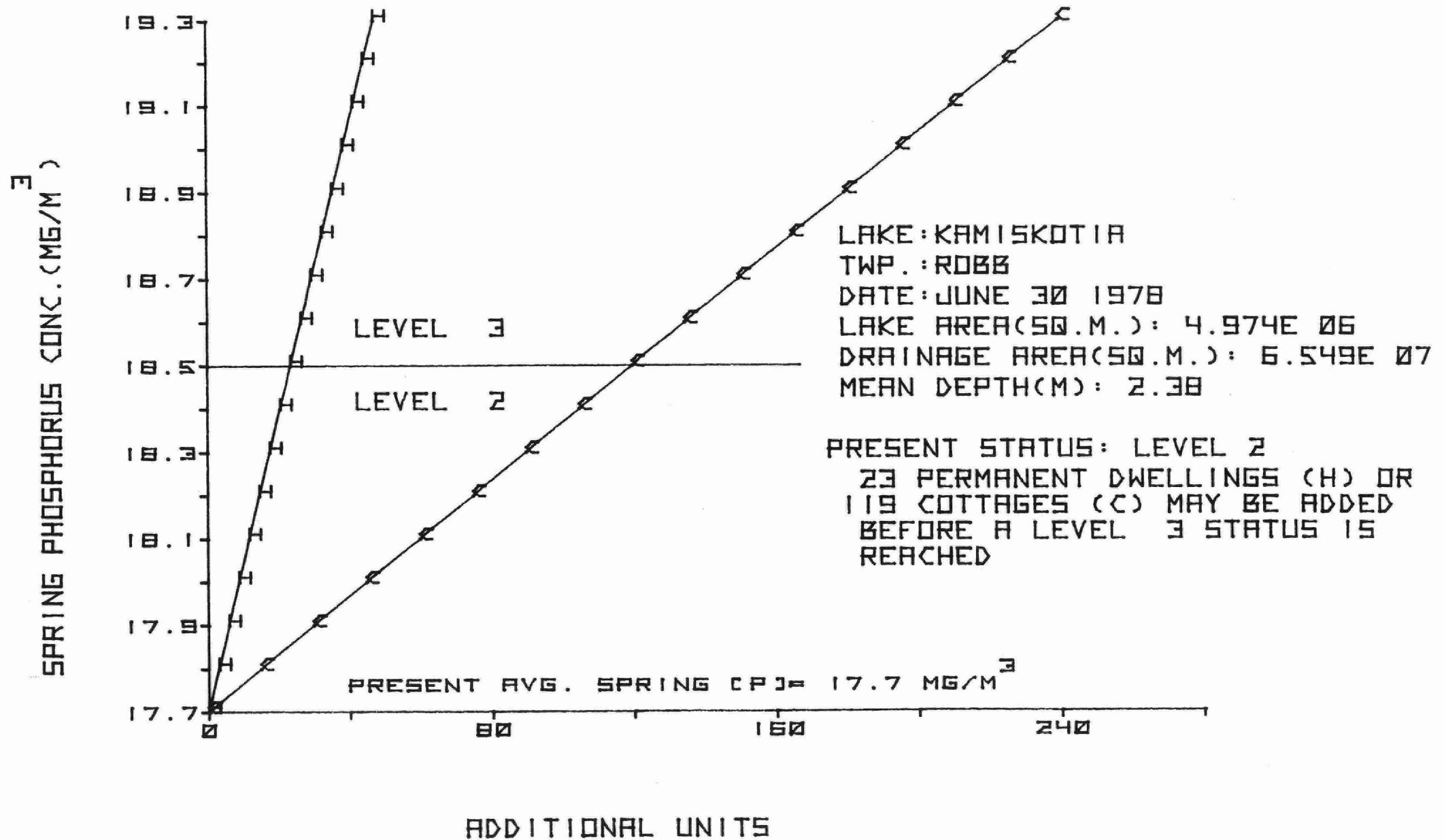
Actual Phosphorus Loading(mg/sq.m/yr): 328.04
Actual Phosphorus Supply(kg/yr): 1631.78

MEASURED SPRING PHOSPHORUS CONCENTRATION(mg/cu.m): 17.7

Theoretical Phosphorus Loading(mg/sq.m/yr): 240.43
Theoretical Phosphorus Supply(kg/yr): 1196.00

THEORETICAL SPRING PHOSPHORUS CONCENTRATION(mg/cu.m): 13.0

NORTHEAST REGION M.O.E.
LAKE DEVELOPMENT CAPACITY AFTER DILLON'S MODEL



Water transparency or clarity was low but was related to natural factors like suspension of silt and clay particles by wave action along with high colouration (orange-brown) due to swamp drainage and the presence of iron.

Concentrations of heavy metals in Kamiskotia Lake and its inflows were low except zinc which was detected in quantities with potential for chronic toxicity to aquatic organisms. The elevated zinc levels were thought to be the result of natural availability.

Because Kamiskotia Lake was shallow and easily mixed by wind turbulence no thermal stratification was evident. Dissolved oxygen concentrations were favourable on all sampling dates.

The bacteriological water quality of Kamiskotia Lake was generally good. Some deterioration over the summer was observed at a few shoreline stations where elevated bacterial densities were found; however, the overall bacteriological water quality of the lake was not affected.

A theoretical phosphorus budget and development capacity based on the ability of Kamiskotia Lake to assimilate additional nutrient loading, revealed that the actual phosphorus concentration measured was significantly higher than the theoretically expected value. It was thought that greater than expected phosphorus export from the geological basin and possible artificial inputs from shoreline development were responsible for the difference.

Based on the measured spring phosphorus concentration of 17.7 mg/m³, the development capacity of Kamiskotia Lake was calculated as 119 cottages or 23 permanent dwellings.

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1. Dillon, P. J., 1974, A manual for Calculating the Capacity of a Lake for Development. Ontario Ministry of the Environment.
2. Guidelines and Criteria for Water Quality Management in Ontario. Ministry of the Environment, 1974.



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